

# THREATENED SPECIES SCIENTIFIC COMMITTEE

Established under the *Environment Protection and Biodiversity Conservation Act 1999*

---

The Minister's delegate approved this Conservation Advice on 04/07/2019.

## Conservation Advice

### *Petrogale concinna concinna*

Nabarlek (Victoria River District)

*Note: The information contained in this conservation advice was primarily sourced from 'The Action Plan for Australian Mammals 2012' (Woinarski et al., 2014). Any substantive additions obtained during the consultation on the draft are cited within the advice. Readers may note that conservation advices resulting from the Action Plan for Australian Mammals show minor differences in formatting relative to other conservation advices. These reflect the desire to efficiently prepare a large number of advices by adopting the presentation approach of the Action Plan for Australian Mammals, and do not reflect any difference in the evidence used to develop the recommendation.*

#### **Taxonomy**

Generally accepted as *Petrogale concinna concinna* (Gould 1842).

Three subspecies of *Petrogale concinna* have been described; the other two subspecies are *P. c. canescens* (Nabarlek (Top End)) and *P. c. monastria* (Nabarlek (Kimberley)). The type specimen for the species is the only specimen known of *P. c. concinna*, and the separation of *P. c. canescens* by Thomas (1909) was largely on the basis of pelage colour (rich rusty versus dull rufous). The validity of the three subspecies has not been tested by modern genetic methods, and the geographic bounds (particularly of *P. c. concinna* and *P. c. canescens*) are not resolved (Woinarski et al., 2014). However, the subspecies have been accepted by the Australian Faunal Directory.

#### **Summary of assessment**

##### **Conservation status**

Critically Endangered: Criterion 3 C2(a)(ii)

The highest category for which *Petrogale concinna concinna* is eligible to be listed is Critically Endangered.

*Petrogale concinna concinna* has been found to be eligible for listing under the following listing categories:

Criterion 2: B1 B2 (a),(b)(iii): Endangered

Criterion 3: C2(a)(ii): Critically Endangered

Criterion 4: Endangered

*Note:* The IUCN tag "Possibly Extinct" is appropriate for this taxon (see assessment summary, page 8).

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

## **Reason for conservation assessment by the Threatened Species Scientific Committee**

This advice follows assessment of new information provided to the Committee to list *Petrogale concinna concinna*.

## **Public Consultation**

Notice of the proposed amendment and a consultation document were made available for public comment for 32 business days between 24 March 2015 and 8 May 2015. Any comments received that were relevant to the survival of the subspecies were considered by the Committee as part of the assessment process.

## **Species/Subspecies Information**

### **Description**

The Nabarlek is a small wallaby, with a head and body length of 29–35 cm and a tail length of 22–31 cm. The fur is dull rufous on the back, marbled with light grey and black (brilliant rust-red in the Victoria River District subspecies), and grey-white on the underside. An indistinct dark grey to black shoulder-stripe is sometimes present. It has a black brush tip on the tail. The species is unique among the marsupials in producing an unlimited number of supernumerary molars (Sanson & Churchill 2008).

The Nabarlek (Victoria River District) can be distinguished from the other two subspecies by its more brilliant rust-red back. The markings on the face and sides are the least contrasted of the three subspecies (Troughton 1943). It has indistinct lateral markings and pale grey-brown limbs (Eldridge & Coulson 2015). It is also the smallest of the three subspecies, the hind-foot including the nail being around 100mm in length (Troughton 1943).

### **Distribution**

The type specimen of Nabarlek (Victoria River District) was collected about 100 km upstream of the mouth of the Victoria River in the Northern Territory, near present-day Timber Creek, in 1839 (Eldridge 1997). There are no records of the subspecies at the type locality subsequent to the original collection, despite some sampling in the general area (Churchill 1997; Fisher & Woinarski 2002; DENR pers. comm., 2017). It was not recorded in a detailed ethno-biological account of the area (Widjiburru et al., 2010). Nabarleks subsequently recorded from the Daly River and Mary River catchments to the north-east (Parker 1973; Churchill 1997) are most likely referable to the subspecies *P. c. canescens*; although, given the lack of genetic analysis or comprehensive morphological scrutiny, this attribution is based mostly on biogeographic grounds (Potter et al., 2012).

The Nabarlek (Victoria River District) was also recorded from the Wyndham area of the East Kimberley, Western Australia, in the early 1900s (Thomas 1909). However, there is no specimen related to this record in the museum collections, and its identification cannot be confirmed (M. Eldridge pers. comm., 2018; DBCA pers. comm., 2018). Iredale & Troughton (1934) and Calaby & Richardson (1988) mistakenly identified the site of the type specimen as near Wyndham. There are no records of the subspecies in the greater Wyndham region since the early 1990s, despite surveys which have recorded *Petrogale brachyotis* (Short-eared Rock-wallaby) there (DBCA pers. comm., 2018).

### **Adequacy of survey**

The subspecies is known from only one specimen (the type from the Victoria River Region in the Northern Territory) and one other record from near Wyndham in the Kimberley, Western Australia.

The Northern Territory Government carried out biodiversity surveys in the Victoria River region in 2015 and 2017. These were not targeted at the Nabarlek (Victoria River District), but evidence of the subspecies might expect to have been encountered if present; the surveys were also not

exhaustive, but covered a reasonable number of potential localities. Remote gorge areas with potential habitat remain unsurveyed. The surveys did not locate the species, from which it can be inferred that if the subspecies is still extant in the region, it occurs in very low numbers and/or is very restricted in range.

There have been numerous vertebrate fauna surveys in the East Kimberley this century, including several near Wyndham. These frequently recorded the closely-related *P. brachyotis* (Short-eared Rock-wallaby), but *P. concinna* and *P. burbridgei* (Monjon) have never been reported among the East Kimberley survey sites in recent decades.

### Relevant Biology/Ecology

Studies of other Nabarlek subspecies show that Nabarleks inhabit rugged rocky areas, typically dominated by sandstone but occasionally by granite (Churchill 1997; Telfer et al., 2008). They shelter during the day in caves located in cliffs and rockpiles, and emerge at night to feed. In the cooler months they may emerge during daylight hours. Studies of the Nabarlek (Top End) report that the dietary items include a variety of grasses, sedges, ferns and forbs (Sanson et al., 1985; Telfer & Bowman 2006).

In the Northern Territory, the Nabarlek probably breeds throughout the year, but a greater number of pouch young have been observed in the wet than in the dry season. Young leave the pouch at about six months of age and reach sexual maturity in the second year of life (Sanson & Churchill 2008). Longevity in captivity is 11.7 years (AnAge 2012). The generation length is assumed to be around five years (Woinarski et al., 2014).

### Threats

The main threats to the Nabarlek (Victoria River District) are predation by feral cats (*Felis catus*) and frequent, extensive and intense fires.

Table 1 – Threats impacting the Nabarlek (Victoria River District) in approximate order of severity of risk

Threat factor	Consequence rating	Extent over which threat may operate	Evidence base
Predation by feral cats	Catastrophic	Entire	Not demonstrated but highly plausible. This is probably ameliorated by the rugged nature of the Nabarlek's habitat, which may limit the hunting success of cats (McGregor et al., 2015; Hohnen et al., 2016a).
Frequent, extensive and intense fires	Major	Entire	There is evidence of ecological degradation associated with the current fire regime across northern Australia (Russell-Smith et al., 2003; Yates & Russell-Smith 2003). However, this is ameliorated by the rugged nature of the Nabarlek's habitat, which breaks up fire patterns and provides shelter from fire (Woinarski et al., 2014; Hohnen et al., 2016b).

Habitat degradation due to livestock and feral herbivores	Moderate	Large	Domestic livestock and feral herbivores may change the floristic composition, and reduce the abundance of preferred plant foods, at some sites. Although the abundance of feral herbivores in rugged areas favoured by Nabarleks is typically low (Woinarski et al., 2014), Nabarleks may come out to forage in flats adjacent to the rocky ranges.
---	----------	-------	---

**How judged by the Committee in relation to the EPBC Act Criteria and Regulations**

<b>Criterion 1. Population size reduction (reduction in total numbers)</b>				
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4				
		<b>Critically Endangered Very severe reduction</b>	<b>Endangered Severe reduction</b>	<b>Vulnerable Substantial reduction</b>
<b>A1</b>		<b>≥ 90%</b>	<b>≥ 70%</b>	<b>≥ 50%</b>
<b>A2, A3, A4</b>		<b>≥ 80%</b>	<b>≥ 50%</b>	<b>≥ 30%</b>
A1	Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.			(a) direct observation [ <i>except A3</i> ]
A2	Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.			(b) an index of abundance appropriate to the taxon
A3	Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(a) <i>cannot be used for A3</i> ]			(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
A4	An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.			(d) actual or potential levels of exploitation
				(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

*based on any of the following:*

**Evidence:**

**Insufficient data to determine eligibility**

There have been no records of the Nabarlek (Victoria River District) at its type locality in the Northern Territory (NT) since it was first recorded in 1839, nor in the Wyndham area in Western Australia (WA) since the early 1900s. This is despite some sampling in the general area of the type specimen (Churchill 1997; Fisher & Woinarski 2002; DENR pers. comm., 2017) and considerable sampling in the East Kimberley (DBCA pers. comm., 2018).

The Committee considers that there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

<b>Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy</b>			
	<b>Critically Endangered Very restricted</b>	<b>Endangered Restricted</b>	<b>Vulnerable Limited</b>
B1. Extent of occurrence (EOO)	< 100 km <sup>2</sup>	< 5,000 km <sup>2</sup>	< 20,000 km <sup>2</sup>
B2. Area of occupancy (AOO)	< 10 km <sup>2</sup>	< 500 km <sup>2</sup>	< 2,000 km <sup>2</sup>
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

**Evidence:**

**Eligible under Criterion 2 B1 B2 (a),(b)(iii) for listing as Endangered**

If still extant, Woinarski et al. (2014) estimate the extent of occurrence to be 1000 km<sup>2</sup> and the area of occupancy to be around 100 km<sup>2</sup>. The AOO was roughly estimated based on the area of suitable habitat (rugged areas) in the vicinity of the type locality, and the EOO estimated by drawing a polygon encompassing these areas of suitable habitat (J. Woinarski pers. comm., 2017). Although these estimates are of low reliability, they suggest that the subspecies at least meets the threshold for Endangered under subcriteria B1 and B2. If still extant, the subspecies likely occurs in one location (which meets subcriterion (a)), and has an inferred continuing decline in the quality of habitat as a result of fires (which meets subcriterion (b)(iii)) (Woinarski et al., 2014).

The Committee considers that the subspecies' extent of occurrence and area of occupancy are likely to be restricted (and possibly very restricted), and the geographic distribution is precarious for its survival because its occurrence is limited and a decline in the number of individuals may be inferred or projected. Therefore, the subspecies meets the relevant elements of Criterion 2 to make it eligible for listing as Endangered.

<b>Criterion 3. Population size and decline</b>			
	<b>Critically Endangered Very low</b>	<b>Endangered Low</b>	<b>Vulnerable Limited</b>
Estimated number of mature individuals	<b>&lt; 250</b>	<b>&lt; 2,500</b>	<b>&lt; 10,000</b>
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	<b>Very high rate 25% in 3 years or 1 generation (whichever is longer)</b>	<b>High rate 20% in 5 years or 2 generations (whichever is longer)</b>	<b>Substantial rate 10% in 10 years or 3 generations (whichever is longer)</b>
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(i) Number of mature individuals in each subpopulation	<b>≤ 50</b>	<b>≤ 250</b>	<b>≤ 1,000</b>
(a) (ii) % of mature individuals in one subpopulation =	<b>90 – 100%</b>	<b>95 – 100%</b>	<b>100%</b>
(b) Extreme fluctuations in the number of mature individuals			

#### **Evidence:**

#### **Eligible under Criterion 3 C2(a)(ii) for listing as Critically Endangered**

The Nabarlek (Victoria River District) has not been recorded for at least 110 years. This is despite some limited sampling in the general area of the type specimen (Churchill 1997; Fisher & Woinarski 2002) and additional survey effort in 2015–2017, some of which was targeted specifically at locating this species (DENR pers. comm., 2017), and considerable sampling in the East Kimberley. A summary of the most recent surveys is provided below.

#### Survey data

Between 2015 and 2017, a number of surveys were undertaken within potential habitat for the Nabarlek (Victoria River District) in the NT. Whilst not all of these surveys were targeted surveys for the subspecies, they employed suitable methods for detection, such as spotlighting and camera traps. In addition, where scats of a suitable size and shape were found within potential habitat, these were collected and sent for DNA analysis. A summary of these surveys is presented below. The survey effort within Gregory National Park covered a limited extent of suitable habitat for the Nabarlek, and was not sufficient to reliably ascertain the absence of the subspecies within the park (DENR pers. comm., 2017).

#### *2015 Bushblitz surveys – Gregory National Park (NT):*

Three sites were surveyed in suitable habitat for the Nabarlek using standard biodiversity monitoring methods, including a five camera trap array per site deployed for five weeks. A further three sites were set up with a five camera array in suitable habitat to the north-east of the park, after an unusual small rock-wallaby was observed in the area (DENR pers. comm., 2017).

#### *2017 Top End Monitoring – Gregory National Park (NT):*

Two sites were surveyed in suitable habitat as part of the Northern Territory Government Top End monitoring program, both of which were also sampled for Bushblitz. All were surveyed using standard biodiversity monitoring methods, including a five camera trap array per site for five weeks. Opportunistic searches for small scats were also undertaken, but no suitable specimens were found (DENR pers. comm., 2017).

### 2017 Bushblitz surveys – Bradshaw Field Training Area (NT):

Targeted surveys were undertaken for the Nabarlek in Bradshaw. Scat searches were undertaken and 14 scats were collected for DNA analysis. Camera traps were set up at 16 sites, four of which were in the same locations as the scat searches (DENR pers. comm., 2017).

### Wyndham region (WA):

There have been numerous vertebrate fauna surveys in the East Kimberley this century, including several near Wyndham. These frequently recorded the closely-related *P. brachyotis* (Short-eared Rock-wallaby) but *P. concinna* and *P. burbidgei* (Monjon) have never been reported among the East Kimberley survey sites in recent decades (DBCA pers. comm., 2018).

## Conclusions

The Nabarlek (Victoria River District) was not detected during the 2015 and 2017 surveys at the type locality, nor in recent surveys in the East Kimberley. The surveys covered multiple locations within suitable habitat, and suggest that the subspecies is likely to be extinct. However, the surveys were not sufficiently extensive to determine its absence, and large areas of suitable habitat in the general area of the known record remain unsurveyed. Given the difficult to access terrain in some parts, and the persistence of the other two Nabarlek subspecies that have similar threatening processes, there is a small chance that the Nabarlek (Victoria River District) still exists. To be eligible for listing under the Extinct category, there must be 'no reasonable doubt that the last individual has died' (IUCN Standards and Petitions Subcommittee 2017).

Based on the absence of recent records, if still extant, the subspecies is estimated to have a very small population size (fewer than 200 mature individuals) occurring in one subpopulation, with an inferred continuing decline due to ongoing threats (Woinarski et al., 2014). This satisfies subcriterion C2(a)(ii). Predation by feral cats is likely to have contributed to initial declines in the population and, if the subspecies persists, predation by cats, as well as changed fire regimes and grazing by introduced herbivores, are probably causing ongoing pressure. However, there are no data on the rate of declines within the last three generations. It is possible that the subspecies is extinct (see Criterion 1), and these inferences are an appropriate precautionary approach in the event that the subspecies is recorded.

The Committee considers that, if the subspecies persists, it is likely to be in very low numbers, occurring in one subpopulation, with an inferred continuing decline. Therefore, the subspecies meets the relevant elements of Criterion 3 to make it eligible for listing as Critically Endangered.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low (Medium-term future) <sup>1</sup>
Number of mature individuals	< 50	< 250	< 1,000
D2 <sup>1</sup> Only applies to the Vulnerable category Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time	-	-	D2. Typically: area of occupancy < 20 km <sup>2</sup> or number of locations ≤ 5

<sup>1</sup> The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a species under D2. As such, a species cannot currently be listed under the EPBC Act under Criterion D2 only. However, assessments may include information relevant to D2. This information will not be considered by the Committee in making its recommendation of the species' eligibility for listing under the EPBC Act, but may assist other jurisdictions to adopt the assessment outcome under the [common assessment method](#).

**Evidence:**

**Eligible under Criterion 4 for listing as Endangered**

If still extant, the number of mature individuals is estimated to be fewer than 200 (Woinarski et al., 2014), which meets the threshold for listing as Endangered under this criterion.

The subspecies likely occurs in one location, with an inferred continuing decline in the quality of habitat as a result of fires. If the subspecies is not already extinct, ongoing pressures from predation by feral cats and fire could drive it to extinction in a very short time. Therefore, the subspecies also meets the threshold for listing as Vulnerable under subcriterion D2.

The Committee considers that, if the species is still extant, the total number of mature individuals is likely to be very low. Therefore, the subspecies meets the relevant elements of Criterion 4 to make it eligible for listing as Endangered.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

**Evidence:**

**Insufficient data to determine eligibility**

Population viability analysis has not been undertaken.

**Summary**

The Nabarlek (Victoria River District) is known from the type specimen, collected in 1839 in the Victoria River District of the Northern Territory, and from a brief note of a specimen collected from the Wyndham area in Western Australia before 1909. Biodiversity surveys in these regions since have failed to detect the subspecies, although there have been few targeted searches for the subspecies and there are remote gorge areas where it may persist. Consequently this assessment is hampered by data deficiency. If the subspecies does persist, it is likely to be in very small numbers and to have a geographic distribution that is precarious for its survival. Predation by feral cats is likely to have contributed to initial declines in the population and, if the subspecies persists, this predation as well as changed fire regimes and grazing by introduced herbivores, are likely to remain significant threats. The two other subspecies are both listed as threatened. The subspecies has been found eligible for listing as Endangered under Criteria 2 B1+2 ab(iii) and 4 D, and as Critically Endangered under Criterion 3 C2a(ii).

Given the subspecies has not been recorded for at least 110 years and there have been multiple surveys in apparently suitable habitat that have not been successful, it is probable that the subspecies is now extinct. However, listing as Extinct requires there to be no reasonable doubt that the subspecies no longer persists. Since targeted searches for the subspecies have not been exhaustive, there is a possibility that it persists in remote gorges, so it cannot be listed as Extinct.

The IUCN Red List Guidelines allow for species to be listed as ‘Critically Endangered (Possibly Extinct)’. The addition of ‘Possibly Extinct’ is not a separate threat category, but rather a ‘tag’ which may be applied to Critically Endangered species that are likely to be Extinct, but for which confirmation is required. This tag is appropriate for the Nabarlek (Victoria River District). As the EPBC Regulations do not currently include provision for applying the ‘Possibly Extinct’ tag, the

subspecies is eligible for listing as Critically Endangered under the EPBC Act, meeting Criterion C2(a)(ii). States or territories may apply the 'Possibly Extinct' tag for species listed as Critically Endangered, where appropriate, consistent with the [Common Assessment Method](#).

## **Conservation Actions**

### **Recovery Plan**

The Committee recommends that there should not be a national recovery plan for *Petrogale concinna concinna* (Nabarlek (Victoria River District)), as a recovery plan would not have a conservation benefit above existing mechanisms.

A recovery plan for Nabarleks and some other rock-wallabies that occur in the Northern Territory, South Australia and Western Australia has been prepared by the Western Australian Department of Parks and Wildlife (Pearson 2013). Other management advice is presented in Roache (2011).

### **Conservation and Management Actions**

There is currently no species-specific management for the Nabarlek (Victoria River District). The geographical range of the subspecies, if still extant, is not currently known. It is thought that individuals may possibly be located in Gregory National Park, which together with the adjacent Bradshaw (Juliki) Defence Area is subject to fire management. Recommended management actions are outlined in the table below.

<b>Theme</b>	<b>Specific actions</b>	<b>Priority</b>
Active mitigation of threats	(If any colonies are located) control feral cats	High
	(If any colonies are located) identify and implement appropriate fire regimes	Medium-High
	(If any colonies are located) control access and regulate military activities	Medium-High
	(If any colonies are located) limit access by introduced herbivores to areas adjacent to the rocky habitat	Medium-High
Captive breeding	(If any colonies are located) establish an insurance population, if a risk assessment indicates that it is safe to do so	High
Translocation	(If any colonies are located) assess options for potential sites for translocation, especially those that may provide some security against feral cats and fires	Medium-High
Community engagement	Involve Indigenous ranger groups in survey, monitoring and management activities	Medium-High

### **Survey and monitoring priorities**

<b>Theme</b>	<b>Specific actions</b>	<b>Priority</b>
Survey to better define distribution	Undertake a targeted survey of all potentially suitable areas within the subspecies' possible range	High
	(If any colonies are located) assess population size (or relative abundance)	High
Establish monitoring program	(If any colonies are located) design monitoring protocols	High
	(If any colonies are located) implement an integrated monitoring program linked to assessment of management effectiveness	High

## Information and research priorities

Theme	Specific actions	Priority
Assess impacts of threats on species	(If any colonies are located) assess impact of feral cats	Medium-High
	(If any colonies are located) quantify the relative impacts upon the population of a range of current fire regimes, and the mechanisms by which those fire regimes have impacts on the subspecies	Medium-High
Assess effectiveness of threat mitigation options	(If any colonies are located) assess changes in population parameters when feral cats are controlled, and under different fire regimes	Medium
Captive breeding	(If any colonies are located) develop a decision framework to identify the feasibility of captive breeding, including a risk assessment for removal of individuals from the wild	High
Resolve taxonomic uncertainties	Resolve subspecies-level taxonomy	Medium-High
Assess diet, life history	(If any colonies are located) identify key dietary items, and impacts of fire upon these	Medium
Undertake research to develop new or enhance existing management mechanisms	Develop broad-scale, targeted feral cat control technology	Medium

## Recommendations

- (i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Critically Endangered category:
- Petrogale concinna concinna*
- (ii) The Committee recommends that there should not be a recovery plan for this subspecies.

Threatened Species Scientific Committee  
4 December 2018

## References cited in the advice

- Burbidge, A.A. and McKenzie, N.L. (1989). Patterns in the modern decline of Western Australia's vertebrate fauna: causes and conservation implications. *Biological Conservation* 50, pp. 143-98.
- Calaby, J. H. and Richardson, B. J. (1988). Macropodidae. In D. Walton, *Zoological catalogue of Australia, 5 Mammalia* (pp. 60-80). Canberra: Australian Government Publishing Service.
- Churchill, S. (1997). Habitat use, distribution and conservation status of the Nabarlek, *Petrogale concinna*, and sympatric rock-dwelling mammals. *Australian Mammalogy* 19, 297-308.
- Eldridge, M. D. B. (1997). Taxonomy of rock-wallabies, *Petrogale* (Marsupialia: Macropodidae). II. An historical review. *Australian Mammalogy* 19, 113-122.

- Eldridge, M.D.B. and Coulson, G.M. (2015). Family Macropodidae (kangaroos and wallabies). Pp. 630-735 in *Handbook of the mammals of the world. Volume 5. Monotremes and marsupials*. D.E. Wilson, R.A. Mittermeier (eds). Lynx Edicions, Barcelona, Spain
- Fisher, A. and Woinarski, J. (2002). *Assessment of the vertebrate fauna of the Bradshaw (Juliki) field training area, Northern Territory*. Report to the Australian Heritage Commission. Darwin: Parks and Wildlife Commission of the Northern Territory.
- Hohnen, R., Tuft, K., McGregor, H. W., Legge, S., Radford, I. J. and Johnson, C. N. (2016a). Occupancy of the invasive feral cat varies with habitat complexity. *PLoS ONE* 11(9), e0152520. <https://doi.org/10.1371/journal.pone.0152520>
- Hohnen, R., Tuft, K., Legge, S., Walters, N., Johanson, L., Carver, S., Radford, I.J.J and Johnson, C.N. (2016b). The significance of topographic complexity in habitat selection and persistence of a declining marsupial in the Kimberley region of Western Australia. *Australian Journal of Zoology* 64, 198-216.
- Iredale, T. and Troughton, E. Le G. (1934). A checklist of the mammals recorded from Australia. *Memoirs of the Australian Museum* 6, 41-45.
- McGregor, H., Legge S., Jones, M. E. and Johnson, C. N. (2015). Feral cats are better killers in open habitats, revealed by animal-borne video. *PLoS ONE* 10, e0133915.
- Parker, S. A. (1973). An annotated checklist of the native land mammals of the Northern Territory. *Records of the South Australian Museum* 16, 1-57.
- Pearson, D. (2013). *Recovery plan for five species of rock wallabies: Black-footed rock wallaby (Petrogale lateralis) Short-eared rock wallaby (Petrogale brachyotis), Monjon (Petrogale burbidgei), Nabarlek (Petrogale concinna), Rothschild rock wallaby (Petrogale rothschildi)*. Western Australian Department of Environment and Conservation.
- Potter, S., Eldridge, M. D. B., Taggart, D. A. and Cooper, S. J. B. (2012). Multiple biogeographic barriers identified across the monsoon tropics of northern Australia: phylogeographic analysis of the brachyotis group of rock-wallabies. *Molecular Ecology* 21, 2254-2269.
- Roache, M. (2011). *The action plan for threatened Australian macropods*. Sydney: WWF-Australia.
- Russell-Smith, J., Yates, C., Edwards, A., Allan, G. E., Cook, G. D., Cooke, P., Craig, R., Heath, B. and Smith, R. (2003). Contemporary fire regimes of northern Australia, 1997–2001: change since Aboriginal occupancy, challenges for sustainable management. *International Journal of Wildland Fire* 12, 283-297.
- Sanson, G. D. and Churchill, S. K. (2008). Nabarlek *Petrogale concinna*. In 'The mammals of Australia'. Third edition. (Eds S. Van Dyck and R. Strahan.) pp. 370-371. Reed New Holland: Sydney.
- Sanson, G. D., Nelson, J. E. and Fell, P. (1985). Ecology of *Peradorcas concinna* in Arnhem Land in a wet and a dry season. *Proceedings of the Ecological Society of Australia* 13, 65-72.
- Telfer, W. R. and Bowman, D. M. J. S. (2006). Diet of four rock-dwelling macropods in the Australian monsoon tropics. *Austral Ecology* 31, 817-827.
- Telfer, W. R., Griffiths, A. D. and Bowman, D. M. J. S. (2008). The habitat requirements of four sympatric rock-dwelling macropods of the Australian monsoon tropics. *Austral Ecology* 33, 1033-1044.
- Troughton, E (1943). *Furred animals of Australia*. Sydney: Angus and Robertson.

Widjiburru, B., Harrington, D., Balwanjer, R., Roberts, E., Waterloo, P., Roberts, L., Harrington, R. N., Roberts, J., Nemit, N., Moerkerken, C. and Wightman, G. (2010). Ngarinyman plants and animals. Aboriginal knowledge of flora and fauna from Judbarra/Gregory National Park and the Victoria River area, northern Australia. *Botanical Bulletin* 34. Northern Territory: Department of Natural Resources, Environment, the Arts and Sport; and Diwurruwurru-Jaru Aboriginal Corporation.

Woinarski, J. C. Z., Burbidge, A. A. and Harrison, P. L. (2014). *The action plan for Australian mammals 2012*. Collingwood, Australia: CSIRO Publishing.

Yates, C. and Russell-Smith, J. (2003). Fire regimes and vegetation sensitivity analysis: an example from Bradshaw Station, monsoonal northern Australia. *International Journal of Wildland Fire* 12, 349-358.

### **Other sources cited in the advice**

AnAge (2012). The animal aging and longevity database. Available on the internet at: <http://genomics.senescence.info/species/>

Department of Biodiversity, Conservation and Attractions (DBCA 2018). Personal communication by email, 10 and 24 September 2018.

Department of Environment and Natural Resources (DENR) (2017). Personal communication by email, 29 September 2017.

Eldridge, M. (2018). Personal communication by email, 28 August 2018. Principal Research Scientist, Terrestrial Vertebrates, Australian Museum Research Institute.

IUCN Standards and Petitions Subcommittee (2017). Guidelines for Using the IUCN Red List Categories and Criteria. Version 13. Prepared by the Standards and Petitions Subcommittee. Available on the internet at: <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>

Woinarski, J. (2017). Personal communication by email, 28 November 2017. Charles Darwin University.